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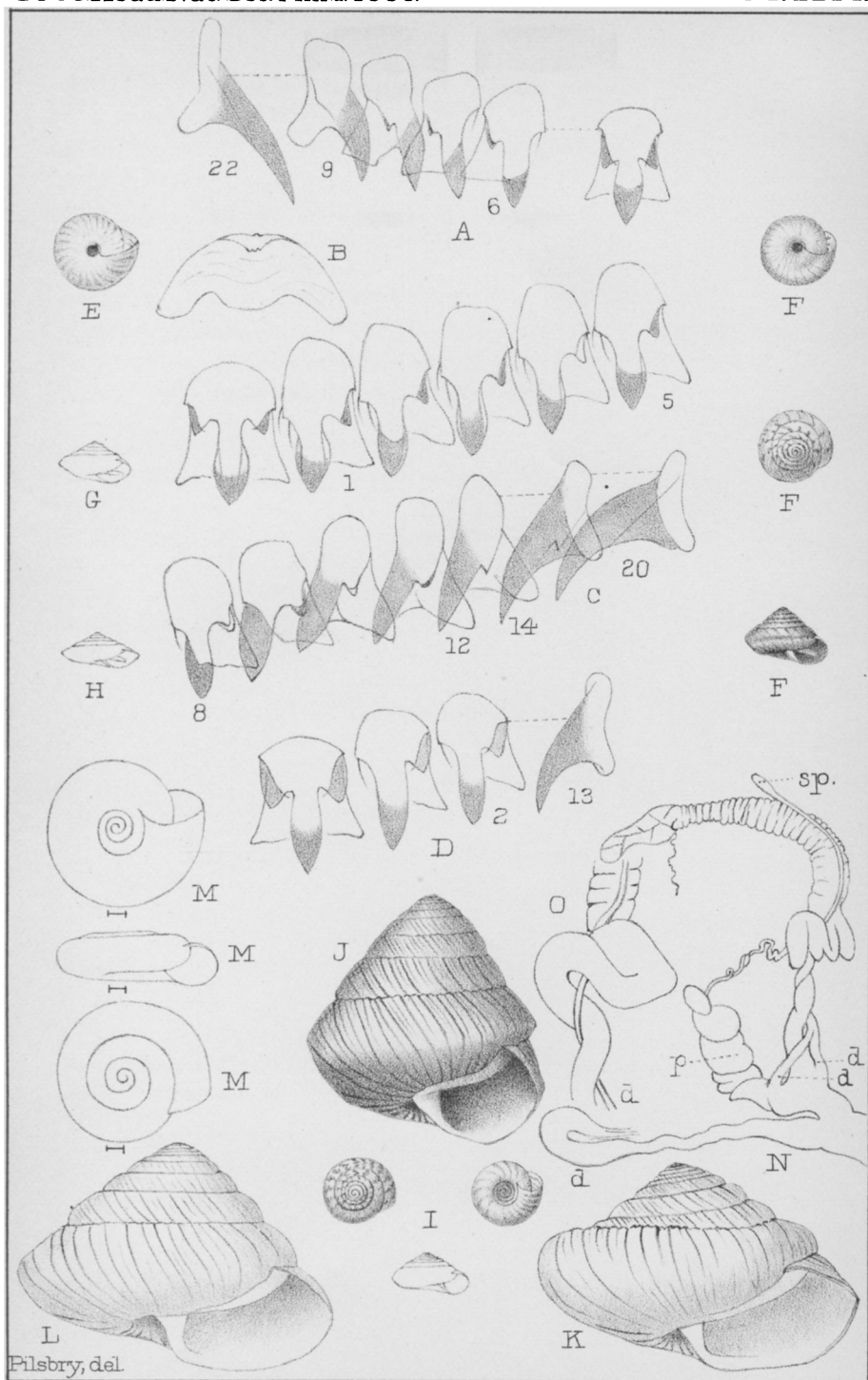
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Pilsbry, Helicoid Land Mollusks of Bermuda.

## ON THE HELICOID LAND MOLLUSCS OF BERMUDA.

BY H. A. PILSBRY.

Through the courtesy of Professor Angelo Heilprin I have been enabled to study the Bermudan land shells, collected by the party conducted by him during the past summer. Among them were examples of all the Helicoid species which have been reported by previous observers from the island, some containing the living animal. The species, with the exception of a number of artificially introduced European shells, are mostly forms well-known from various West Indian localities; such as *Helix cereolus* var. *microdonta* Desh., *H. vortex* Pfr. and others; but besides these, there are a number of shells peculiar to Bermuda; and these last have furnished material for the following notes.

The helicoid species confined to Bermuda are as follows: *H. bermudensis* Pfr., *H. nelsoni* Bld., *H. reiniana* Pfr., *H. circumfirmata* Redf., *H. discrepans* Pfr. As to the systematic position of these forms there has been considerable difference of opinion among authors; the first, *H. bermudensis*, has been placed in *Caracolus* by Von Martens, in *Hyalina* by Clessin, in *Zonites* by Bland; *H. reiniana* has been considered a *Patula* by Pfeiffer, Clessin, Tryon and Fischer; and *H. circumfirmata* and *discrepans* have been placed in *Microphysa* by Von Martens and Binney, in *Hyalosagda* by Clessin, Tryon and others.

Thus it will be seen that these species have been distributed into several genera in two distinct families. Upon examining the soft parts, however, I find that all have essentially the same organization and without doubt belong to the same genus.

Dr. O. Boettger proposed in 1884, for the Lower Miocene fossil *Helix imbricata* Braun, and the *H. bermudensis* Pfr. the name of *Pæcilonites*. He gave no diagnosis of the new group, but assigned it a position between the typical palæarctic *Zonites* and the American groups *Zonyalina* and *Moreletia*, a position which the anatomical characters prove to be erroneous.<sup>1</sup>

1 " \* \* \* Endlich sei noch einer nahen Verwandten der Hoheim-  
er untermiocänen *Helix imbricata* Al. Braun gedacht, die Sandberger bekanntlich  
zu *Trochomorpha* (*Discus*) gestellt hat. Ich gebe die Aehnlichkeit zu; aber zur  
Section Videna H. u. A. Adams, *Discus* Alb., möchte ich die betreffende fossile Art  
nur ungern stellen, da alle mir bekannten lebenden Arten dieser Gruppe zum min-  
desten einer verdichteten Basalrand, der oft recht erheblich Helix-artig umgeschlagen

By error, the genus was quoted "*Poecilozonites Sandberger*," in the Zoölogical Record for 1884, and this error was repeated by Tryon<sup>1</sup> who gives the first diagnosis of the group published, giving *H. bermudensis* as the type and only species. We may, then, consider the *H. bermudensis* Pfr., the type species of the genus. Whether the *H. imbricata* Braun be associated with the Bermudan shells or not is a point still to be settled. The superficial resemblance is marked; but as the history of the species of *Poecilozonites* teaches us, "systematizing" helicoid land mollusks by the shells alone is the merest guess-work.

The fact that the fossil species which Dr. Boettger proposes to unite with the Bermudan form is from the Lower Miocene formation of Germany, is in itself no great objection to the view that they are congeneric; for no fact is better established in malaco-geography than the close affinity existing between the European Tertiary land mollusca and those now inhabiting the West Indies.<sup>2</sup> To explain this relationship existing between two regions separated by the whole expanse of the Atlantic, various theories have been offered. One of the most plausible is that which bridges the Atlantic by an ancient (Eocene, Early and Middle Miocene) continent—an *Atlantis*.

ist (wie z. B. bei *Tr. merziana* Pfr.) besitzen. Viel näher liegt daher wohl der vergleich der *Helix imbricata* mit der etwas kleineren, mit zwei braunen bändern gezierten *Hyalinia bermudensis* Pfr. von den Bermudas, deren Uebereinstimmung in allen wesentlichen charaktern bei directem Vergleich sofort in die Augen springen dürfte. Freilich kommen wir hier fast von dem Regen in die Traufe, da die systematische stellung dieser lebenden Art selbst noch in hohen Grad unsicher ist, was ihr Autor durch ein vorgesetztes '?' sehr richtig selbst schon angedeutet hat. Bei *Hyalinia* kann sie unmöglich bleiben. Da sie meiner Ansicht nach auch nicht in die indische, indo malayische und polynesische gattung *Trochomorpha* passt, so dürfte eine eigene Gruppe für *Hyal. Bermudensis* und *Helix imbricata* zu errichten sein, für welche ich den Namen *Poecilozonites* vorschlage, und die ich am liebsten zwischen die ächten paläarktischen *Zonites* und die tropisch-amerikanischen Gruppen *Moreletia* und *Zonyalina* vorläufig als section in der Gattung *Zonites* Montf. einreihen möchte, bis die Anatomie der lebenden Art eine mehr gesicherte Stellung im System an die Hand geben wird." O. Boettger in *Neues Jahrbuch für Mineralogie, Geologie u. Palaeontologie*, 1884, ii Bd., s. 139.

<sup>1</sup> Manual of Conchology, 2d, series, iii, p. 19, 95.

<sup>2</sup> This affinity although doubtless very great, has been considerably exaggerated. There is, for instance, no warrant for referring European tertiary species to the exclusively New World genera *Pleurocera*, *Anculosa*, *Tulotoma*, *Mesodon*, *Carinifex*, *Melantho*, and others. There seems to have been no infusion of European Tertiary types into the North American snail fauna east of the Californian region. This fauna is truly autochthonous.

This view has been advocated by the well-known conchologist Dr W. Kobelt<sup>1</sup> and by others.

But although this theory explains many anomalies in the distribution of molluscs, I must freely confess that the objections to it seem to me almost insurmountable. The recent work of the Challenger, Blake, and other deep-sea explorations, all tend to confirm the view held by Guyot, Dana, Agassiz and others, that the great oceanic basins, practically as they exist to-day, are of great antiquity; and render the existence of a former Atlantic continent with any considerable Western extension, highly improbable.

A view more in accordance with the facts with which we are at present acquainted, seems to me to be the following: It is a well ascertained truth that until toward the close of the Miocene, large portions of Northern Africa as well as Europe were submerged; and it appears probable that the westward flowing Equatorial current of the Indian Ocean extended across northern Africa, and united with the Atlantic northern equatorial current, which now flows westward from northern Africa, through the Antilles into the Gulf of Mexico. This current would afford a means of transport not only for the free swimming embryos of marine molluscs, (and there are not a few forms both of gasteropods and pelecypods, common to the Mediterranean and Gulf Provinces,) but also, through the agency of floating materials, trees, etc., swept from rivers, land mollusks may have been transported across the Atlantic, just as they have been carried by the Gulf Stream from the West Indies to the outlying island of Bermuda,<sup>2</sup> a distance of over 700 miles.

A further development of the same idea explains certain peculiarities in the distribution of species common to the Pacific and the Gulf of Mexico. The presence of Miocene and Pliocene deposits render it certain that there was communication between the Gulf and the Pacific across the isthmus of Panama as late as the Pliocene. And a portion of the equatorial current probably swept directly through to the Pacific. Thus it is likely that those forms common to both sides of the isthmus, will prove to be of Atlantic origin, and to have been distributed westward.

The indigenous Bermudan mollusc-fauna, marine as well as terrestrial, has undoubtedly been derived wholly from the West Indies.

<sup>1</sup> *Nachrichtsblatt d. deutschen Malak. Gesell.*, 1887, p. 147.

<sup>2</sup> See Darwin, *Origin of Species*, 6th ed., p. 353. Also a paper by Mr. C. T. Simpson, *On the Distribution of Land and Fresh-water Shells in the Tropics*. *Conch. Ex.* ii, p. 37, 50.

And since the island is typically oceanic, "a solitary peak rising abruptly from a base only 120 miles in diameter" surrounded on all sides by between 2500 and 3000 fathoms depth, we have an indication here that land mollusks of many families, *Helicidæ*, *Zonitidæ*, *Succinidæ*, *Pupidæ*, *Helicinidæ*, even *Vaginulidæ*, (for a large undescribed species of *Vaginulus* exists upon the island) may be transported very great distances by sea, by, in all probability, the agencies mentioned above.

The considerable divergence existing between the various species of the Zonitoid genus peculiar to Bermuda, *Poecilozonites*, indicates that the island is of considerable antiquity.

We may define the genus as follows:

**POECILOZONITES.**

Generic characters: Shell helicoid, subtrochiform, depressed conic, or subdiscoidal, perforate or umbilicate, obliquely striate, ornamented with radiating zigzag flammules or spiral bands of chestnut color on a lighter ground; whorls numerous (7-10) very slowly widening; body whorl more or less flattened or compressed below the usually carinate periphery, not descending anteriorly; aperture more or less irregularly lunate; peristome simple, the columellar margin slightly expanded and thickened with a white callus which encircles the pillar within. Animal similar in form to *Helix*; foot narrow, short posteriorly, scarcely reaching behind the shell, without longitudinal furrows above its margin or caudal mucous pore; orifice of genitalia on the right side of neck, near, but not under the mantle; mantle margin simple; jaw like that of *Limax*, very thin, arcuate, with a broad blunt median projection anteriorly; radula with tricuspid central teeth having quadrate basal plates, the central cusps projecting beyond the anterior margins of the basal plates, the side cusps rather short, with well reflexed cutting points; lateral teeth similar but asymmetrical, lacking the inner cusps; marginal teeth aculeate, with simple thorn-shaped cusps and oval basal plates.

It will be seen by the above definition that the genus cannot be included in any of the groups with which its species have been associated by authors; the Zonitoid dentition at once removing it from the *Helicidæ*, and the absence of a caudal mucous pore, the more anterior position of the orifice of the genitalia and the coloration of the shell, separating it from *Zonites* and its subgenera.

The relationship of the species of *Poecilozonites* to one another is shown by the similarity of the radulæ and jaws, and of the external characters of the animal; and in the shells, which at first glance seem to be a heterogeneous assemblage, by the callus which coats the columella, the compression of the whorl below the periphery, and especially by the color-pattern, which is the same in all the species, consisting of zigzag flammules radiating from the sutures. In *P. bermudensis* the flammules coalesce into continuous bands above and below the periphery in the adult; but an examination of young specimens reveals the same pattern that is found in *P. circumfirmata*, *P. reiniana*, etc. The internal spiral lamella of *P. circumfirmata* would incline one at first to separate it from the other species; but it is scarcely of generic importance, in view of the fact that in all other characters the species is very similar to *P. bermudensis*, etc.

The following analysis shows the inter-relations of the various species:

- A. Base of shell with a revolving lamina within  
*circumfirmatus*, *discrepans*.
- B. Base of shell without lamina.
  - a. Aperture rounded below; umbilicus wide *reinianus*.
  - b. Aperture angulate below; umbilicus narrow  
*bermudensis*, *nelsoni*.

***Poecilozonites bermudensis*** Pfr. (pl. xvii, figs. E. c.)

The typical species is a form of about twenty-five mill. diameter, solid, coarsely irregularly striate and acutely carinate at the periphery; a broad chestnut band usually encircles the shell above the periphery, and another below it; but these are sometimes absent; the inner whorls of the spire usually retain traces of the original color-pattern of radiating flames, and the base in young examples, is radiately streaked (pl. xvii, fig. E). The base is convex, and not indented around the narrow and deep umbilicus, but is angulated at its margin; the parietal wall is generally covered by a shining white layer with which the interior of the shell is lined. Reeve, Tryon and other authors have figured the shell of this species.

The jaw is like that of *P. circumfirmata*.

The radula (pl. xvii, fig. c) is rather long. The central teeth have basal plates almost as broad as long, the median cusps projecting below their lower margins, with well-developed cutting points, the side cusps short, attaining about the middle of the basal plate, and

directed outward; the lateral teeth are similar, but lack inner cusps; they are about eight in number, and are followed by about four transition teeth; the marginals number about fifty on either side, and their cusps become more slender toward the outer edge, and the basal plates shorter. A central with five adjacent lateral teeth, and a group of transition teeth with a true marginal tooth are shown in the figure.

*Helix albella* of Chemnitz, (not of Linnæus), and *H. ochroleuca* of Pfeiffer, (not Ferussac) are, I believe, synonymous with this species. The former is placed in *Eurycratera* in Pfeiffer's *Nomenclator*, and the latter has been compared to *Pachystyla rufozonata*, a form somewhat similar in characters of the shell, but belonging, of course, to a distinct group.

**Pocillozonites nelsoni** Bland. (pl. xvii, figs. j, k, l).

A fossil form, differing from *bermudensis* in the much greater size, greater number of whorls, more convex base, coarser striation, impressed sutures, and especially in the peculiarly prominent dome-shaped upper whorls. These are, indeed, so closely coiled as to resemble a specimen of *P. circumfirmata*. The coloration, imperfectly shown in several specimens before me, is that of *bermudensis*; and whilst its affinities are with the latter species, I regard it as a divergent branch, rather than as an ancestor of that form.

As has been observed in other cases of species approaching extinction, and probably subject to some decided and unfavorable change in environment, (in this case, perhaps, due to the comparatively recent subsidence and partial submergence of the island<sup>1</sup>) the shell exhibits great mutations and distortions of form; sometimes the spire is elevated conical, sometimes much depressed; frequently the planes of the upper and lower volutions are not parallel, and the spire consequently is canted to one side. The species is remarkably large, solid and roughly sculptured for a Zonitoid.

**Pocillozonites reinianus** Pfr. (pl. xvii, figs. 1).

This heretofore unfigured species is discoidal in form, widely umbilicate, the umbilicus about one-third the diameter of the base, exhibiting all the whorls; the apical whorl is smooth and whitish; the following whorls are quite convex, with deep sutures, brownish, very prettily zigzagly flammulate with chestnut color, like many of the species of *Patula*. The body-whorl in adult examples is round-

<sup>1</sup> See Challenger Report, Narrative, vol. i, p. 138.



ed; the base concave around the umbilicus, and the general aspect that of *Patula*.

The jaw is like that of *circumfirmata*.

The radula (pl. xvii, fig. D) is similar to that of *bermudensis* except in the following points: the cusps are larger, with much more widely reflexed cutting points; the perfect lateral teeth are seven on either side; the change to marginals is quite abrupt, as there are but two real transition teeth; the marginals number about sixteen on each side, the inner six or seven of about equal size, the outer ones rapidly decreasing toward the edge. The basal plates are longer than in the other species. A central tooth with two adjacent laterals and one marginal are shown in the figure.

**Poecilozonites circumfirmatus** Redfield. (pl. xvii, figs. F).

A form with much the appearance of *Hyalosagda*, a group with which it has been classed by some authors. It is a delicate subtranslucent yellowish brown shell, marked with brown streaks, spots and flammules; the whorls are separated by moderately impressed sutures; the apex is like that of *reiniana*; the last whorl is more or less angulate around the periphery, rather flattened below the angle, then convex, indented around the narrow deeply perforating umbilicus; there is a white calcareous deposit around the columella, inside, as in the other species, and an acute white lamella which revolves within the base near to the periphery, a character which none of the preceding species possess. The variation in form is very great—specimens more elevated than my figure F being not infrequent, and these are connected by examples more and more depressed (fig. G) with the flattened lenticular form called by Pfeiffer *H. discrepans*. This extremely depressed variety, now figured for the first time, (Pl. xvii, fig. H.) cannot be considered specifically distinct from the *P. circumfirmata*.

Jaw (pl xvii, fig. B) transparent, very thin, arcuate, with blunt extremities and a wide obtuse median projection below.

Radula (pl. xvii, fig. A) as described for *P. bermudensis*, but with only seven laterals, two or three transition teeth, and about twenty-eight marginals. The marginals have longer basal plates than in *P. bermudensis*.